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Effect of Brassinolide on physico-chemical properties of mango cv. Amrapali grown in new alluvial zones of West Bengal

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Abstract
A study was conducted to investigate the impact of brassinolide on the physico-chemical properties of mango cv. Amprapali at the Regional Research Station, Gayeshpur, Nadia, and West Bengal, India during 2020-2021 in alluvial zone. Five treatments were included in the randomized block design of the trial viz. T_1: Brassinolide 0.5mg/l, T_2: Brassinolide 1mg/l, T_3: Brassinolide 1.5mg/l, T_4: Brassinolide 2mg/l and T_5: control (water spray) and 4 replications. The brassinolide treated plants produced superior fruits in terms of quality as compared to the control treated ones. Fruit weight (g), fruit yield (no. of fruits per plant), TSS (°brix), total sugar (%), titratable acidity (%) and βcarotene (µg/100g) were influenced by brassinolide treatment. Among the different treatments, the treatment with Brassinolide 1mg/l (T2) of water proved to be superior and enhanced both the physical as well as biochemical properties of mango cv Amrapali.

Keywords: Amprapali, brassinolide, mango, physico-chemical properties, polyhydroxy steroids, plant hormone

Introduction
A class of polyhydroxy steroids that exist naturally is commonly known as brassinosteroid (Rao *et al.* 2002) [12] and because of its several advantageous effects, it is classified as the sixth plant hormone after auxin, gibberellins, cytokinin, abscisic acid, and ethylene (Luan *et al*., 2016) [6]. It was extracted from the pollen of the rape seed plant, i.e., *Brassica napus* and hence was named as 'brassins' (Grove *et al*., 1979). Brassinosteroid is a nontoxic and ecologically safe plant hormone that can be utilised in increasing the parameters like growth, yield and quality of agri-horti plants (Coll *et al*., 2015) [2]. Numerous elements of plant biology, such as cell elongation, cell division, root growth, photomorphogenesis, stomatal and vascular differentiation, seed germination, immunity, and reproduction depend heavily on brassinosteroids. Moreover, they play an essential role in controlling the ethylene synthesis, root gravitropic response, and plant oxidation radical metabolism. The growth promoting compound also shows promising effect in different types of stress tolerance mechanism like biotic and abiotic stresses like water stress, drought stress, salinity stress etc. (Nolan *et al*., 2020) [8]. This hormone is conferred as hormones of 21st century, owing to active contribution in large number of physiological processes (Khripach *et al*., 2000) [5]. Over 70 different plant species have yielded BRs thus far. However, just three of them, BL, 24-epibrassinolide, and 28-homobrassinolide, are considered to be the most biologically active forms and are widely employed in physiological research of various horticultural plants. (Aghdam *et al*., 2016; Nawaz *et al*., 2017) [1, 7].

The mango (*Mangifera indica* L.), which belongs to the Anacardiaceae family of cashews, is one of the most significant and extensively grown fruits in the tropical globe. It is renowned for its superior flavor, aroma, and taste, earning it the title of "King of fruits" (Vasanthaiah *et al*., 2007) [14]. Mangoes are a rich source of vitamins A, C, and D. It is the richest source of Vitamin A (4800IU). Mango is one of the most highly demanded fruit crop in the national and international market owing to its wonderful taste, flavour and nutritional values. Mango is a very important fruit crop of tropical regions but very scanty information is available on the effect of brassinolide hormone on this crop so this investigation was undertaken to find out the role of this hormone in effecting the physico chemical quality parameter of mango and also to identify the effective dose and time of application of brassinolide.

Materials and Methods

An experiment entitled 'Effect of brassinolide on physico-chemical properties of mango cv. Amrapali grown in new alluvial zones of West Bengal' was carried out in the Regional Research Station of Bidhan Chandra Krishi Viswavidyalaya, Gayeshpur, Nadia, located at 23.50 ° North and 89 ° East longitude and 9.75 m above mean sea level, West Bengal during the period 2020-2021.This Research Station is situated in the West Bengal's New Alluvial Zone. The soil at the trial site is alluvial in nature and sandy loam in texture having pH 6.6, 192.44 kg/ha nitrogen, 103.72 kg/ha phosphorus the available potassium is 284.11 kg/ha having good water holding capacity and 0.68% organic carbon. The Regional Research Station is located in the Subtropical Humid Region where the maximum temperature ranges between 31.5 °C to 34.56 °C and the minimum temperature range between 17.16°c to 28°c throughout the duration of the investigation. Maximum downpour was recorded in the month of May- June. The experiment was conducted with 3 years old mango tree cv. Amrapali planted at the spacing of 5×5m. The experiment is laid down in Randomized Block Design (RBD) with 5 treatments *viz*. T_1: Brassinolide @ 0.5mg/lt, T_2: Brassinolide @ 1.0mg/l, T_3: Brassinolide@1.50mg/l, T_3: Brassinolide @ 1.5 mg/l, T_5: Brassinolide@2.0mg/l and T_5: Water spray (Control). The spray solutions of brassinolide were created by directly dissolving the necessary amounts of their commercial formulations in water to create mixtures of varying strengths. 15 litres of spray solution were prepared for each treatment, and the trees were sprayed with it with the aid of a sprayer to thoroughly moisten the developing flowers, fruits, and foliage without creating runoff. Applications of the brassinolide solutions were made at opening of flower (25% to 30%) and 15 days following fruit set. The individual fruit weight was recorded using an electronic weighing device, and the average weight was calculated and reported in grams (g). Data on the yield of fruits under different treatment was recorded at the time of harvest by counting the number of fruits and expressed as number of fruits per plant. Total soluble solids (TSS) of the fruit was determined using a hand refractometer (0-32°brix).Total sugar, titratable acidity and β carotene was estimated using the conventional techniques as explained by Ranganna (2002) [11]. Statistical analysis was done using the procedures recommended by Panse and Sukhatme (1985) [9].

Results and Discussion

The Table No. 1 shows that there was a considerable increase in fruit weight (g) with varying brassinolide treatments. The fruit weight (g) ranges between 155g-160g.Among different treatments, brassinolide at the concentration 1.0mg/litre (T_2) showed maximum fruit weight (168.50g) followed by the treatment of brassinolide 1.50mg/litreof water(T_3) while the control treatment (T_5) recorded the minimum fruit weight (155.0g)when compared to the brassinolide treated plants.. Similar result was obtained in yellow passion fruit by Gomes *et al*. (2006) [4]. They noticed that applying brassinolide analogue resulted in enhanced fruit yield and weight.

Unlike fruit weight, the different concentration of brassinolide treatmentsalso had an impact on the yield of fruit.Maximum fruit yield (85 fruits/plant) was recorded from the plant treated with brassinolide 1.0mg/litre of water (T_2) followed by the treatment brassinolide 1.50mg/litreof water (T_3) where the yield was 81 fruits/tree while control treatment (T_5) recorded minimum (75 fruits/tree) when compared to the brsassinolide treated plants as shown in table 1. Similar results were obtained by Pozo *et al.*, (1994) [10]. They found that in grape, application of epibrassinolide during flowering in vines also boosted the overall yield and number of grapes per bunch by 29.90% and 66.70%, respectively, over non-treated plants when utilizing dosages of 0.01 ppm and 0.1 ppm (Pozo *et al*., 1994) [10].

Application of brassinolide also increased several biochemical qualities like total soluble solids. Maximum (21.80° brix) total soluble solid was obtained from the fruits of the plant treated with brassinolide 1.0mg/litre of water (T_2) followed by the TSS reading (20.90° brix) which was obtained from the treatment with brassinolide 0.5mg/litre (T_1) where the control treatment (T_5) recorded the lowest value of TSS (19.80°brix). The outcomes closely align with Vardhini and Rao's (2002) [12] findings. It was reported by them that the treatment with growth regulating substance brassinolide enhanced all portions of carbohydrates, reducing sugar, and enhanced DNA, RNA and protein concentrations. Gomes *et al*., (2006) [4] found that when brassinosteroid analogue B16 is applied to passion fruit at 3 weeks after full bloom stage at a concentration 0.10 mg/l helped in increasing the fruit's total soluble solids significantly.

Results depicted in table shows that different treatments of brassinolide enhanced the fruits' total sugar content (%). Maximum value of total sugar (14.82%) was recorded with the treatment brassinolide 1mg/l (T_2) whereas the control treatment (T_5) recorded the minimum. Comparable outcomes were noticed by Ghosh *et al*., 2022 [3] in litchi where brassinolide when applied twice, 15 days before and after anthesis increased the total sugar (%) significantly.

Brassinolide treatment significantly reduce the titratable acidity. Titratable acidity ranged between 0.22% to 0.30%. The minimum titratable acidity (0.22%) was obtained with brassinolide 1 mg/l (T_1) and the control treatment (T_5) recorded the highest value.

The βcarotene content varied remarkably with the different treatments of brassinolide and ranged between 7210µg/ 100g – 8210 µg/ 100g where the highest value was noted with the treatment of brassinolide 1 mg/l (T_2) followed by brassinolide 0.5 mg/l (T_1) andthe control treatment showed the lowest value (T_5).

Table 1: Effect of Brassinolide on physical and chemical properties of mango

Treatment	Fruit weight (g)	Fruit yield (Number of fruits per plant)	TSS (ºbrix)	Total sugar (%)	Titratable acidity (%)	β carotene (µg/100g)
T_1	160.00	80.00	20.90	14.33	0.23	8100
T_2	168.50	85.00	21.80	14.82	0.22	8210
T_3	167.50	81.00	20.80	14.14	0.23	7932
T_4	165.20	79.00	20.20	14.10	0.24	7979
T_5	155.00	75.00	19.80	13.98	0.30	7210
S.Em (±)	0.302	0.223	0.323	0.118	0.011	11.49
CD (*P*=0.05)	0.931	0.689	0.996	0.365	0.035	35.42

T_1: Brassinolide @ 0.5mg/l, T_2: Brassinolide@ 1.0mg/l, T_3: Brassinolide @1.5mg/l, T_4: Brassinolide@2.0mg/l, T_5: Control (Water spray)

Conclusion

A study examining the impact of brassinolide on the fruit quality of mango cultivar Amrapali, which is cultivated in a recently discovered alluvial zone in West Bengal, demonstrated the efficacy of several brassinolide treatments on the physical and chemical characteristics of the aforementioned mango cultivar. The results of the study showed that various treatments with brassinoliode significantly increased the physical parameters such as fruit weight (g), yield (number of fruits per plant), and biochemical properties such as the fruit's total soluble solids (TSS) content, total sugar (%), titratable acidity (%), and β carotene content (µg/100g) compared to control treated fruits. In conclusion, the physico-chemical properties of mangos were effectively influenced by the exogenous administration of brassinolide. The most successful treatment in terms of boosting fruit weight, yield, and total soluble solids content was brassinolide at 1.0 mg/lt of water, according to the research.

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